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PHENOMENA AND THEIR DETERMINATION.

IN the village of Bryn Mawr there were last year no less than four pairs of little girl twins while, so far as I know, the population did not include a single pair of boy twins. How shall we classify this fact? So far as is known, the sex of offspring is not determined by environment, nor is the occurrence of twins. Shall we then say the fact that four pairs of girl twins have been born in that particular environment and no pairs of boy twins is mere chance coincidence? Doubtless this classification is a proper one for common sense and even for natural science. The fact sets no problem to biological science, nor as a social phenomenon is it really significant. Viewed more largely, however, it is seen to offer certain difficulties. For to regard the fact under consideration as mere coincidence seems to set limits to the determination of events by law, to deny the uniformity of nature. Even if some of us, like William James, be opposed to the notion of a 'block universe' where everything is predetermined and there is no room for human freedom, none of us would be inclined to regard the occurrence of girl twins as falling within the class of events amenable to free choice. On the contrary, the growth of biological science has convinced us all that there are fixed and definite physiological causes which determine the sex of offspring and the production of twins. Just what these conditions are we are not yet sure, but it is not open to us to doubt that the birth of every child is as wholly the outcome of antecedent natural conditions as is the fall of a shower of rain. But if this is our conviction, are we not bound to say that the state of affairs in Bryn Mawr is no mere coincidence, but would reveal itself to a deeper and wider knowledge as the effect of causes acting in accordance with natural laws?

To this question I shall venture to give a negative answer. The birth of each of the four pairs of girl twins we may know to be determined by definite physiological conditions of the parents, but this knowledge is by no means sufficient to tell us why there should be four pairs of parents of this physiological constitution at Bryn Mawr, and no parents of the constitution productive of boy twins. The possession of such constutition and residence in a particular locality have no determinate relationship to each other. And this remains true even though we may believe it to be possible that had one, or even all, of the families in question not lived in this locality, some, or even all, of the twins in question would not have been born. For even though in each individual case residence in the village could be known to be in some measure responsible for the birth of these particular children, this connection could not be generalized—that is, it could not be stated in terms of residence in this village and birth of girl twins.

The point may become clearer if we compare the case of the twins with two other hypothetical cases. Suppose that the census showed the presence in Bryn Mawr of thirty per cent more girls of ages between ten and twenty years than boys of the same ages? How would this fact be classified? Probably as the result of the fact that there are five schools for girls in Bryn Mawr and none for boys. If we investigated the causes which had led the various families in question to reside in Bryn Mawr, we should probably find the same reason given in a majority of cases, viz., the desire to educate daughters. Here, then, a *general* connection obtains between residence in Bryn Mawr and the presence of daughters. In contrast with this is such a case as the following. The directory of a town shows that fifteen per cent of the names of residents begin with *T*, the remaining names being distributed among the other letters. Investigation would doubtless show that each of the *T* individuals had some reason for residence in the town, but the tracing of each separate case to a determining condition would not of itself constitute an explanation of the large proportion of *T* families resident in the town. To explain this phenomenon, it would be necessary to discover some ground common to *T* families and not common to families of other initials—a *general* connection between the initial *T* and residence in this town. In other words, explanation of the items making up a phenomenon is no explanation of the phenomenon.

The *coexistence* of these items also demands explanation; and, for this, recourse must be had to an indefinitely delimited 'antecedent state of affairs,' which merges, for lack of specific limitation, into the whole preceding state of the universe.

What stands in the way of accepting the presence of such real indetermination in the universe as the argument claims is a belief in the dictum that every state of affairs is the outcome of antecedent conditions, and that every state of the universe in its full particularity is determined by the preceding state of the universe. But such a universal determination is virtually indistinguishable from an indeterminism. The dictum is insignificant because of its very generality. Explanation of a given state of affairs which applies equally to every other state of affairs is no explanation. On the contrary, to exhibit any thing or event as determined, is, alike for science and common sense, to exhibit it in its specific character as consequent upon equally specific conditions. I use 'specific' advisedly, for it is only as *specifically* characterized that a phenomenon is amenable to scientific determination. In its full particularity it is a mere *this*. Of a *this* all that it is possible to say is, "It is determined by the universe—God made it." But if in its full particularity a phenomenon is indeterminate, no specification includes all the particularities which we may discern to be there. However specified, and every thing may be classed variously, there are items which remain irrelevant to it as thus specified. These play no part in its determination, do not in fact belong to *what* we are engaged in explaining, although they may be constitutive of the phenomenon as falling within some other class.

What distinguishes indeterminate, or pseudo-phenomena, like the occurrence of girl twins in Bryn Mawr, or the preponderance of *T* families in a given town, from real phenomena, is the fact that they are combinations of items severally determinate, but having no common ground. The items, in other words, form a collocation, but do not constitute a phenomenon. They are not elements into which it may be analyzed, but juxtaposed fragments to which it may be reduced. The primary task of science may be said to be, not the organization of phenomena, but the furnishing the world with real phenomena in place of the fictitious things and events of fancy and myth. Thus astronomy has furnished the world with systems of suns and satellites in place of constellations and zodiacal houses; chemistry has provided reagents instead of talismans, etc. Once the phenomena are provided, the organization of them into systems becomes possible. Or, rather, the same process of thought which distinguishes the phenomena, discerns vaguely at the same time the patterns of their groupings. To complete this pattern, however, it is necessary that the phenomena should be resolved into their elements—the units of design which are the key to the pattern.

The world as it exists for science is a vast network of patterns, the different systems of which overlap and mingle, but which we cannot resolve into a single system of design. The units which we find to be the key of one pattern turn out to be misleading clues when we try to apply them elsewhere. The history of philosophy furnishes us with a long record of fruitless attempts to read the network in terms of the unit of some one pattern. On the other hand, there have been, and still are, those who maintain that the network of things falls into two entirely distinct patterns, the physical and the psychical. These urge that all the larger designs we vaguely discern, whose figures are the things of common life and of the biological and social sciences, reveal themselves to a finer scrutiny as mere complications of the one or the other unit, each distinct from and independent of the other. But neither of these two views is wholly right. The latter is right in denying that no unit suffices to unravel the whole; the former is right in so far as it denies the final independence of the patterns we can trace. For they overlie each other, and while lines and fragments of the one are incorporated in the others, the superposition is, as it were, hit or miss. The elements of design of the one play no part in the pattern of the other. The world is like a great puzzle picture in which we may see now human faces, now animal forms, and now a forest scene. The lines and shades which make the one delineate the others also, but while we see the faces, the forms and the forest disappear, and *vice versa.*

Let us turn to some concrete cases.

The murders at Serajevo will doubtless go down to history as the event which precipitated the great war. This event was the outcome of a political plot against the Austrian government hatched in Servia, and it thus provided an excuse for the attempted subjugation of the smaller state, and indirectly for a German war of conquest. This event, then, was an international affair. Its causes, as well as its effects, can be discerned only by a study of European history. And yet that event was the act of an individual. We do not know in any psychological detail the motives which led the assassin to commit the act, but a hundred contributing factors doubtless played their part—chance scenes, chance words of childhood and youth, etc. So, too, the final act, although committed by one hand, was the result of the words and deeds of his confederates, each of whom was led to the conspiracy by obscure and remote incidents which might be chronicled by their biographers, but which will never figure in the history of Austria or of Servia. For the history of a nation is not made up of the experiences and acts of individuals.

But let us go a little deeper. The murder we should say was the immediate outcome of a conspiracy. We may picture the secret meeting of the conspirators in some attic chamber—the entering one by one of the members, the words of greeting, the discussions. Intermingled with the planning were doubtless bits of irrelevant conversation, tales told, and even, if we are realistic enough in our picture, we should add the varying gestures, the scraping of the chairs, the scratchings of the head, the blowings of the nose. These latter, to be sure, are irrelevant details, which we should not regard as among the acts constituting the meeting. But if we regard the meeting as made up of the acts of the individuals taking part, how shall we distinguish those acts which were constitutive of it from those which were not? So long as we view the event taking place in the attic chamber as a complex of acts of individual organisms—movements of lips and limbs—no 'conspirators' meeting' is discernible. In fact, viewed as a complex of such acts we find no *single* phenomenon at all, but only a collection of coincident occurrences with no more real unity than the co-presence of the four pairs of girl twins in Bryn Mawr. The acts which made up the meeting were such acts as reports, discussions, resolutions, votes; and these disappear when analyzed into acts of individual organisms.

The disparateness of these ways of viewing the event in question becomes even more evident if we consider it in its alternative antecedents and consequents. As a conspirators' meeting, it grew out of the political relationship of Austria and Servia, and led to the assassination of the Archduke and Archduchess, and thence to the war. As a collection of biological phenomena, the various acts were the outcome of the physiological conditions of the various individuals; and the consequences of these acts were in turn to be found in altered physiological conditions—perhaps in wakefulness, indigestion, and general nervous irritability. The antecedent condition in each individual was determined first by heredity, and secondly by the series of environmental conditions to which he had been subject, food, light, air, etc. Immediately, many of them were direct responses to sense stimuli. The movements of pushing back chairs, of handshakings, of nose-blowings, all had direct sense stimuli. So also had some at least of the vocal utterances, so far as they are analyzable into such physiological elements as contractions of vocal chords, expulsion of breath, etc. Similarly, we must suppose that the subsequent behavior of those individuals was indefinitely modified by the stimuli received and the responses made at this time. But it is beyond the scope of biological science to trace the movements of the assassin in pulling the trigger to auditory stimuli received at the meeting. It is only when we regard these auditory stimuli as significant speeches that we are led to relate them to the assassination and arrest of the conspirators.

But the occurrences of the meeting lend themselves to other forms of description. They are resolvable into mechanical movements in space and time, involving transformations of energy, or, again, into a complex of chemical changes. But the items discriminable in neither of these views consitute a single phenomenon, but, again like the case of the twins or the *T* families, make up only a collection of juxtaposed fragments. Their several antecedents and consequents are not common; nor is there any reason from either a mechanical or a chemical view to single out, as effects of these phenomena, mechanical or chemical items occurring at the assassination.

What is true of this event is true, in greater or less degree, of any set of happenings which our natural or acquired interests may select. Like the puzzle picture, it may take on varying forms as our vision shifts. If we would see clearly, and understand the meaning of what we see, we must hold our vision steady, for the setting to which one picture belongs is not that of the others. According to our manner of viewing and of describing what we see, will the figures of our picture be related or unrelated to the varying figures of other visions, and our world become ordered in its various ways.

If the preceding considerations be just, they have important consequences. I have elsewhere attempted briefly to show the bearing such a conception has on the problem of the dualism of the physical and the psychical. In a later article I hope to discuss more specifically the relation of mind and body and to show how these same principles may be made the basis of a modified behaviorism. The remainder of the present article I propose to devote to a discussion of its bearing on atomism.

The general criticism commonly passed on atomism by monists is levelled against the assumed independence of the elements in question. Definable only in terms of their relations, it is urged, they are themselves merely relative, and hence logically dependent on the whole. Into this debate as to the logical priority of element or whole, it is beside our purpose to enter. It is not the independence of the elements which we shall question, but the essential incapacity of an atomism to furnish adequate principles of individuation and classification for the determination of the objects held to be constituted by the atomic elements in question.

The simplest case is that of physical atomism. The world of sensible objects which make up our universe—the stones and grass, the streams and clouds—is throughout composed of whirling masses of atomic particles. The familiar objects about me in the room with their sensible qualities of color, of warmth or cold, of hardness or softness, of brightness or dullness, would reveal themselves to a finer perception as myriads of particles of different shapes and sizes, here densely packed, there far apart, and ever whirling and dancing in varying patterns. But were we beings endowed with faculties capable of perceiving this world in all its minute detail, we should no longer find in it the objects of our human world. We could not see the wood for the trees. Even though for every discriminated difference in our human world we should be able to point out a variation of some sort in atomic structure and arrangement, the resolution of the atomic world into the world of human perception would appear a mere *tour de force*. For the selection, from among all the multifarious actual variations in the atomic world, of those variations which correspond to sensible differences in the human world, would be wholly arbitrary. No principle of selection would be discoverable. The reason for this lies of course in the fact that the perceptual world is relative to the human organism. It is diversity in *relationship* to the living human being which determines the sensible differences we recognize. Variations in the atomic world which do not count as different in their bearing on the organism are not perceived as different. The world as we directly experience it is a world whose features are brought into relief through their projection upon human nature. Taken out of relation to this nature, these features must appear as fragments arbitrarily cut from the atomic world.

So far we have considered atomism in what we may call its pictorial form, conceiving the atom as an entity which a finer perception might reveal to us. But what we find true of physical atomism conceived thus naïvely, holds as well of its more sophisticated forms. The atom of modern physics and chemistry is not an entity endowed with qualities; it is rather a counter in whose terms are reckoned various types of measurable changes. Its value lies partly in the fact that it furnishes a convenient aid to the analysis of complicated processes, but chiefly in the fact that it serves to relate and systematize diverse classes of phenomena, such as temperature changes, chemical reactions, and electrical phenomena. Thus the rise in temperature of a bar of iron when pounded, its combination with a definite weight of oxygen to form ferric oxide, its increase in length when magnetized, and a host of other phenomena it presents, all are explained and related on the supposition of the atomic structure of the iron bar. They are all ideally describable as changes in the equilibrium of atomic forces within the bar. Indeed we may describe the iron bar itself as a complex of atomic elements in a state of equilibrium, the maintenance of which is essential to the integrity of the bar. But we cannot say that all the phenomena which the bar exemplifies are describable in such terms. Nor is the limit to such description wholly factual. There are indeed many phenomena observable in connection with the bar which are not at present explicable in terms of the atomic hypothesis (such as the various forms of steel into which it may enter), but which we may reasonably expect will some day be explained in similar terms. But there are theoretical limits to the applicability of the atomic hypothesis. Consider, for example, the principle of the lever. The iron bar in certain mechanical relations becomes a lever, and while some of the essential conditions of its acting as a lever, *e. g.*, its rigidity, may be referred to its atomic structure, the *principle of the lever* is not describable in terms of atomic relationship. Any actual concrete example of a lever may be a complex of atoms, and any particular case of its action may be ideally describable in terms of readjustments of atomic relationships, but though we had complete descriptions of the atomic changes occurring in a thousand particular cases of raising a weight by means of a lever, we should not find in these descriptions that uniformity of which the principle of the lever is a statement. The same is true in general of the principles of molar mechanics. They are *uniformities of a different order* from those of so-called molecular or atomic relationships. Were we endowed with powers which enabled us to observe the changes undergone by sidereal systems in their relations to each other, we might conceivably be led to formulate laws of such behavior which would bear to our laws of molar mechanics a relation analogous to that obtaining between those laws and chemical principles. In such unimagined events the force of gravity which we now universalize may control mere irrelevant detail, just as the processes of oxidation which play so important a part in terrestrial phenomena, are irrelevant detail in the movements of the solar system.

Limitations similar to those to which we thus find physical atomism to be subject obtain as well for psychological atomism. According to this theory, all the objects of sense perception are analyzable into groups of sensation elements, or sense data, together with the relations obtaining between these elements. Thus, of yonder oak tree all that is discoverable by inspection is patches of color of differing sizes and shapes, or, if touched, hardness, coldness, etc.[1] Any observable changes which the tree undergoes, whether those resulting from a shifting of my position, or from varying illumination, or from the growth or decay, or even the felling of the tree and chopping it into firewood, are ideally describable in terms of changes in sense data and their relations. In the same way, my particular observations of any sensible phenomenon might be described in terms of sense data, the approach of winter, my experimental verifications of the fact that the addition of baking powder to flour mixtures causes them to rise in baking, or my observation of the behavior of falling bodies. But my observation of the approach of winter this year and last, stated in terms of actually experienced sense data, would yield no characteristic identity.[2] The general phenomenon 'the approach of winter' cannot be described in terms of coexistences and sequences of sensation elements. Much less can we construe in terms of such atomism any such principle as the law of falling bodies. This is essentially the criticism which John Stuart Mill passed upon Berkeley's dictum that the laws of nature are merely statements of the order in which God sends us our perceptions. As Mill urged, the laws of nature represent uniformities, not between groups of sensations, but between objects and events. Not a single causal relationship is analyzable into a sequence of sensation groups. That Mill was further led by his associationism to define an object as a group of possibilities of sensation does not prejudice the truth of this insight.

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[1] With the essential inadequacy of psychological atomism as a theory of perception we are not here concerned. For a discussion of this see articles on "Sensation and Perception," *The Journal of Philosophy, Psychology and Scientific Methods.* XIII, No. 20 and No. 23.

[2] For another presentation of this same general principle see article "The Limits of the Physical," *Philosophical Essays in Honor of James Edwin Creighton*, p. 175.

The fact is that the inspection which resolves the perceived object into a group of sensation elements is not properly an analysis of the object at all.[1] The sensation elements which are the result of such 'introspective analysis' no more truly constitute the objects of the sensible world than the muscular movements of the individuals at a meeting constitute that meeting. Whatever pattern the 'medley of our sensations' may make, its figures bear no determinate relation to the forms whose interweavings make up the perceived universe.

We may sum up the results of the foregoing discussion as follows.

A distinction must be made between pseudo-phenomena and real phenomena. A pseudo-phenomenon is a collection of items, each of which may constitute a real phenomenon, but whose individuation is merely arbitrary. As a whole, that is to say, it does not bear systematic relations to other wholes individuated and classified by similar principles. Hence, as a whole, it is indeterminate, or, what is the same thing, has no *specific* determination, but can be causally referred only to the universe at large.[2]

An equally important distinction is that between the analysis of a phenomenon into its constituent *elements*, and the reduction of it to a collection of items occupying the same *locus*. What is true of it considered in the one character is not necessarily true of it considered in the other. How far any two descriptions of the same *this*, or *locus*, may be mutually interchangeable, *i. e.*, may be taken as alternative descriptions of the *same* phenomenon is a matter, in each case, for empirical investigation. But because certain features belonging to the one description may be found to coincide with discriminable features of another description, it does not follow that the descriptions will coincide throughout.

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[1] For a further discussion of this point see articles on "Sensation and Perception."

[2] Further instances of such pseudo-phenomena are, the distribution of trumps in a given deal of cards, the Great Dipper, the muscular movements of the members of Congress during the debate and passage of the Food Control Bill, and the chemical reactions occurring in the body of Shakespeare during the composition of *Macbeth*.

Philosophical atomism, like any other theory maintaining the universality of a given type of determination, falls into this error, and assumes that because any *locus* may be described in a given set of terms, any *phenomenon* of the universe may be so described. A similar error has given rise to the problem of the dualism of the physical and psychical as I have elsewhere attempted to show.[1] That the more specific problem of the mind-body relation also rests upon such a confusion of thought, I hope to argue later.

GRACE ANDRUS DE LAGUNA.

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[1] See "The Limits of the Physical," *Philosophical Essays in Honor of James Edwin Creighton*, p. 175.